# INSTRUCTION MANUAL

MICROLITER MODEL 250 # 2 NEW
PROP. of 814 METER ROOM

KAY ELECTRIC CO.
PINE BROOK, N. J.

May 1, 1958

# INSTRUCTION MANUAL

for the

# MICROLTER MODEL 50

Pine Brook, N. J.

CA 6-4000

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SECTION I

GENERAL DESCRIPTION

## A. APPLICATION.

The Kay **MICROLTER** is a wide band, low level, vacuum tube voltmeter designed to measure a-c voltages with a high degree of accuracy. In addition to its primary use as a vacuum tube voltmeter, provision has been made for the **MICROLTER** to function as a video amplifier.

## B. FEATURES.

A general investigation of designs for wide-band, low-level, high-frequency, vacuum tube voltmeters led to the abandonment of overall feedback amplifiers with their attendant frequency limitations. Stabilizing techniques are incorporated to reduce to a very small value the normal fluctuation of non-feedback type amplifiers.

The **MICROLTER** reaches new performance standards at high frequencies heretofore unavailable except by complex combinations of narrow band tuners or by heterodyne techniques. A unique design, employing extremely wide-band amplifiers, has made possible the **MICROLTER**.

This is a non-feedback type voltmeter. However, stabilization it provided for steady state changes and against line voltage variations.

The **MICROLTER** permits the measurement of low level r-f signals. A 7-position switch provides full scale steps of 1, .3, .1, .03, .01, .003 and .001 volts, the lowest reading being 250 microvolts. These ratios permit an easily read meter scale.

There is no tuning and the meter is direct reading, the voltage range being set by a single dial. A 1%, 6" mirrorback meter is employed in order to obtain maximum readability. In addition to the voltage scales, there is a decibel scale calibrated in decibels below 1V.

## C. SPECIFICATIONS.

**Frequency Range:** 100 cps to 50 megacycles.

**Accuracy:** ±10% of full scale reading.

**Frequency Response:** ±1 db.

**Voltage Range:** 1 millivolt to 1 volt full scale in 7 ranges.

**Sensitivity:** 250 microvolts.

**Video Amplifier Output:** 0.25 volts at 75 ohms.

**Video Amplifier Gain:** 47 db (max.).

**Meter Sensitivity:** ±1% accuracy. Maximum readability is obtained by the use of a mirrorback meter face.

**Tube Complement:**

| Amplifier: | | | | Power Supply: | | | |
|---|---|---|---|---|---|---|---|
| V-1 | 5718 | V-5 | E180F | V-201 | 5U4 | V-205 | 12AU7 |
| V-2 | E180F | V-6 | E180F | V-202 | 6AQ5 | V-206 | 6AG5 |
| V-3 | E180F | V-7 | E180F | V-203 | 6AQ5 | V-207 | OB2 |
| V-4 | E180F | V-8 | 6BK7A | V-204 | 6AQ5 | | |

**Dimensions:** 10" x 8" x 7".

**Weight:** 17 lbs.

**Length of Cable from Probe to Instrument:** Approx. 40".

## D. EQUIPMENT SUPPLIED.

1. **MICROLTER** with attached high impedance probe.
2. 70 ohm output cable.
3. Instruction Manual.

# SECTION II
# INSTALLATION

## A. GENERAL.

The **MICROLTER** is designed for table-top operation and thus presents no special installation problems. However, to insure optimum operation, the equipment should not be subjected to excessive moisture, vibration or temperature conditions. The installation should also include provision for connection to a 190 watt source of 117V (±10%), 50-60 cps, a-c power

## B. INTERCONNECTION DATA.

Use as a Voltmeter.

1. Connect the **MICROLTER** power plug to a 190 watt source of 117V (±10%), 50-60 cps, a-c power.
2. Set the range switch to the appropriate scale.
3. Connect the probe to the voltage source being measured.

Use as an Amplifier.

1. Connect the probe to the circuit from which the signal is to be amplified.
2. Connect an output cable from the **AMPLIFIER OUTPUT** jack to obtain the amplified r-f voltage.

# SECTION III
# OPERATION

## A. IDENTIFICATION OF CONTROLS.

1. **Power Switch** *(S-4)*. This toggle switch controls the application of all a-c power to the **MICROLTER MODEL 50**. When this switch is in the off (lower) position, the entire unit is de-energized. When this switch is in the **ON** (upper) position, the adjacent red indicator light comes on, indicating that the equipment is ready to use.

2. **METER - AMPLIFIER Switch** *(S-2)*. When this switch is in the **METER** position, the **MICROLTER MODEL 5C** functions as a sensitive broad-band vacuum tube voltmeter which measures the signal at the input in terms of volts rms and decibels. When this switch is in the **AMPLIFIER** position, the metering circuit is disconnected and the **MICROLTER** functions as a broad-band amplifier with a maximum gain of 47 db.

3. **AMPLIFIER OUTPUT Jack** *(J-1)*. When the **MICROLTER** is used as a broad-band amplifier, the amplified signal appears at this BNC-type UG-185/U panel jack. The output impedance is a nominal 70 ohms. According to the position of the range switch, the signal level may be -13, -3, 7, 17, 27, 37 or 47 db referred to the input. External connections to this jack should be made with a BNC-type UG-260/U and a 70 ohm coaxial cable.

4. **Meter** *(M-1)*. When the **MICROLTER** is used as a vacuum-tube voltmeter, this sensitive microammeter is used to indicate the voltage level of the signal under test. It is calibrated both in volts and in decibels below 1V, and is accurate to within ±1%.

5. **Range Switch** *(S-1)*. This rotary switch is used to set the gain of the internal amplifier to the proper level and select the appropriate range for the voltmeter. When the instrument is used as a vacuum-tube voltmeter, setting the range switch to the extreme clockwise position (**-60DB .001V**) enables the operator to read voltages on the order of 250 to 1000 microvolts. Similarly, for voltmeter applications, the extreme counterclockwise position enables the operator to read signals up to 1V rms.

When the **MICROLTER** is used as an amplifier, (with the **METER - AMPLIFIER** switch in the **AMPLIFIER** position), the setting of *S-1* determines the gain of the amplifier. However, under these conditions, an internal 13 db loss must be subtracted from the gain values shown in the switch calibration. Thus, the **-60 DB** position actually provides a gain of 47 db, the **-50 DB** position a gain of 37 db, etc.

6. **Probe Assembly.** The **MICROLTER** probe should be connected directly to the source of signal being measured or amplified. At 1 Mc, the input impedance of the probe is 4.5$\mu\mu$f, shunted by one megohm; at 50 Mc, 4.5$\mu\mu$f shunted by 30 kilohms.

*The following internal potentiometers are factory adjusted and normally should not be changed unless necessitated by component replacement or serious misalignment of the equipment.*

7. **Amplifier Gain Adjustment Controls** *(R-16, R-36, R-50, R-64, R-78 & R-92)*. Each of these six internal potentiometers controls the gain of one of the cascaded amplifiers. They are adjusted to provide a 10 db gain for each stage of amplification.

8. **B+ Adjustment** *(R-213)*. The setting of this internal potentiometer, located on the power supply chassis, controls the B+ level to the amplifying and measuring circuits. It is adjusted for a +250V B+ output.

9. **Meter Adjust Potentiometer** *(R-110)*. This internal potentiometer adjusts the detector characteristic to match the meter scale.

10. **Hum Adjust Potentiometer** *(R-112)*. This control balances the 60 cycle voltage fed to the heaters of the tubes. It is properly adjusted when the meter reading of the **MICROLTER** is lowest, with the probe shorted.

B. OPERATING PROCEDURE.

1. Connect the **MICROLTER MODEL 50** power plug to a 190 watt source of 117V (±10%); 50-60 cps, a-c power.

2. Turn the power switch to the **ON** position.

3. If the **MICROLTER** is to be used as a vacuum-tube voltmeter, set the **METER - AMPLIFIER** switch to the **METER** position.

*a.* Set the range switch to the 1V position.

*b.* Connect the probe to the voltage source being measured.

*c.* Turn the range switch to successively lower voltage positions until a reading is obtained.

*d.* The exact voltage level may now be obtained from the tabulation below.

| RANGE SWITCH POSITION | VOLTAGE SCALE | DIVIDE METER READING BY |
|---|---|---|
| -60DB .001V | Upper | 1000 |
| -50DB .003V | Lower | 1000 |
| -40DB .01V | Upper | 100 |
| -30DB .03V | Lower | 100 |
| -20DB .1V | Upper | 10 |
| -10DB .3V | Lower | 10 |
| 0DB 1V | Upper | 1 |

4. If the **MICROLTER** is to be used as a wide-band amplifier, set the **METER - AMPLIFIER** switch to the **AMPLIFIER** position.

*a.* Use a 70 ohm coaxial cable to connect the **AMPLIFIER OUTPUT** jack to the ultimate point of use.

*b.* Using the tabulation below as a guide, set the range switch to provide the desired degree of gain.

| RANGE SWITCH POSITION | AMPLIFIER GAIN |
|---|---|
| -60DB .001V | +47 DB |
| -50DB .003V | +37 DB |
| -40DB .01V | +27 DB |
| -30DB .03V | +17 DB |
| -20DB .1V | +7 DB |
| -10DB .3V | -3 DB |
| 0DB 1V | -13 DB |

*c.* Connect the probe to the signal source.

## SECTION IV

## THEORY OF OPERATION

The primary function of the **MICROLTER** is to provide an accurate measurement of low voltages over a wide frequency range. The **MICROLTER** may also be utilized as a wide-band video amplifier with a gain of 47 db.

The circuits include:

A. Input Probe.

B. Voltage Amplifiers.

C. Metering Circuits.

*Figure 4* is a block diagram of the above circuits showing their relationship to each other.

### A. INPUT PROBE.

The function of this input probe is to provide a high input impedance and a low input capacitance for the **MICROLTER**. This stage further provides a low impedance output which is used to drive a 150 ohm coaxial cable from the probe to the amplifier. The signal is coupled from the circuit under test through the network *C-1*, *R-1* to the attenuator network, *C-2*, *R-2* and *R-5* which applies it to the control grid of *V-1*. The variation of the signal on the grid causes a corresponding variation at the cathode resistor, *R-8*. The output from this resistor drives the coaxial cables and is applied to *S-1*, the range switch, and in turn is applied to the correct video amplifier.

### B. VOLTAGE AMPLIFIERS *(V-2 & V-7)*.

These six tubes are connected in cascade and are employed as frequency compensated video amplifiers. Each stage utilizes fixed bias which is adjusted by means of the grid potentiometer to give an accurate 10 db gain. The setting of the range switch will determine the number of amplifiers in use. For example, the 0.001V range uses all six amplifiers, the 0.01V range uses only four stages of amplification, etc.

The individual amplifiers are simply video stages whose high frequency compensation is accomplished by two tunable coils *(L-1 to L-12)* in each plate circuit.

**C. METER CIRCUIT** *(V-8)*. The output from the plate of *V-7* is impressed on the grid of *V-8*, the cathode follower, through *C-47*, the coupling capacitor and *R-102*, the grid bias resistor. The circuit comprising *R-100*, *R-101*, *C-54* and *C-48a* form the plate bypass and decoupling network. The output is taken from the cathode across *R-103* and *R-104*. The cathode signal coupled through *C-49* is applied to *S-2*, the **METER - AMPLIFIER** switch. With the switch in the **AMPLIFIER** position, the signal is applied to the **AMPLIFIER OUTPUT** jack *(J-1)* through the frequency compensating network of *L-13*, *R-106*, *R-107* and *C-50*. In the **METER** position of *S-2*, the signal is applied to the voltage doubler circuit formed by the crystal diodes *D-1* and *D-2*, and the condensers *C-49*, *C-51* and *C-52*. The detected output voltage is impressed on the meter through *R-10* and *R-110*.

SECTION V

MAINTENANCE

## A. TROUBLE LOCATION.

If the operation of the **MICROLTER** appears to be defective in any respect, first ascertain that the cause of improper operation is not in the circuit under test. If a process of elimination indicates that the trouble originates in the **MICROLTER**, make the following preliminary checks:

1. Make a visual check to determine that all filaments are lit, and that there are no loose connections or obviously damaged components.

2. Measure the a-c line voltage (105-125V) and the B+ input (250V).

The most common troubles encountered with the **MICROLTER** are weak or defective tubes, crystal diode failures, and occasional misalignments. The trouble location chart below may be used as a guide to isolate the trouble to a particular circuit or stage. *Figure 3* is a complete schematic of the measuring and power supply circuits.

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| No reading on any range. | *V-1* defective. | Check and replace *V-1*. |
| | Dirty contacts on *S-1a* and *S-1b*. | Clean *S-1a* & *S-1b* with a suitable contact cleaner. |
| | *V-7* and/or *V-8* defective. | Replace *V-7* and/or *V-8* and re-align as per Section V, paragraph B. |
| | *D-1* and/or *D-2* defective. | Replace *D-1* and/or *D-2*. Re-align as per Section V, paragraph B. |
| No reading or inaccurate reading on 0.001V range, but other ranges alright. | *V-2* defective. | Check and replace *V-2*. |
| | Coils *L-2* & *L-7* mistuned. | Re-align as per Section V, paragraph B. |
| | Incorrect bias on *V-2*. | Re-adjust *R-16*, see Section V, paragraph B. |
| No reading or inaccurate reading on 0.001V and 0.003V range, but other ranges alright. | *V-3* defective. | Check and replace *V-3*. |
| | Coils *L-3* & *L-8* mistuned. | Re-align as per Section V, paragraph B. |
| | Incorrect bias on *V-3*. | Re-adjust *R-36*, see Section V, paragraph B. |
| No reading or inaccurate reading on 0.001V, 0.003V & 0.01V ranges, but other ranges alright. | *V-4* defective. | Check and replace *V-4*. |
| | Coils *L-4* & *L-9* mistuned. | Re-align as per Section V, paragraph B. |
| | Incorrect bias on *V-4*. | Re-adjust *R-50*, see Section V, paragraph B. |

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| No reading or inaccurate reading on 0.001V, 0.003V, 0.01V and 0.03V ranges, but other ranges alright. | *V-5* defective. | Check and replace *V-5*. |
| | Coils *L-5* and *L-10* mistuned. | Re-align as per Section V, paragraph B. |
| | Incorrect bias on *V-5*. | Re-adjust *R-64*, see Section V, paragraph B. |
| No reading or inaccurate reading on 0.001V, 0.003V, 0.01V, 0.03V and 0.1V ranges. | *V-6* defective. | Check and replace *V-6*. |
| | Coils *L-6* and *L-11* mistuned. | Re-align as per Section V, paragraph B. |
| | Incorrect bias on *V-6*. | Re-adjust *R-78*, see Section V, paragraph B. |

## B. ALIGNMENT & ADJUSTMENT.

Equipment needed: Voltmeter (RCA Voltohymst or equivalent.)
Scope (Dumont 304A or equivalent).
Marka-Sweep Model Video 50 (Kay Electric Co.).
Accurate High Frequency VTVM.
Precision Attenuator (10 db in 1 db steps).
Precision 70 ohm Attenuator (50 db in 10 db steps).
Signal Generator.
75 ohm Detector.

1. Set B+ at 250 volts.

2. Check B+ to probe - should read about 160 volts at *C-207*.

3. Meter linearity check - Connect signal generator (set to approximately 2 Mc) to attenuator with 1 db steps and connect **MICROLTER** to attenuator (the equipment should be impedance matched). Set generator output to give 0 db reading on **MICROLTER** meter. Add attenuation in 1 db steps- **MICROLTER** meter db scale should track attenuation, if it doesn't, adjust *R-110* until it does.

4. Voltage Calibration - Set signal generator output for 0.3V, using accurate r-f voltmeter. Switch **MICROLTER** to .3V range, and connect **MICROLTER** to signal generator. If **MICROLTER** does not read .3V, then adjust *R-92* until it does.

5. Amplifier Alignment:

   *a.* Install (temporarily) 1000$\mu\mu$f condenser between *C-49* and pin 8 of *V-8* (YBK7).

   *b.* Connect *MODEL VIDEO 50* r-f output to attenuator with 10 db steps and connect **MICROLTER** to attenuator (again using an impedance matched system).

   *c.* Throw *S-3* to off position.

   *d.* Throw **METER - AMPLIFIER** switch to **METER** position and set range switch to .3V position.

   *e.* Connect scope X-axis amplifier to junction of *R-109* and *S-3*.

   *f.* Set scope for as large a deflection as is practical (say 3") and flatten amplifier response using coils *L-1* and *L-12*.

   *g.* Reduce r-f input to **MICROLTER** by 10 db using precision attenuator. Turn range switch to .1V position, flatten amplifier using coils *L-6* and *L-11* and set scope for exactly same deflection as was used in previous step by adjusting *R-78*.

*h.* Repeat step *g* for .03, .01, .003 and .001 positions.

*i.* Turn the range switch to the 1 volt position (this position attenuates signal by 10 db) and set flatness by adjusting *C-8*. If the attenuation of this position is more than 10 db, shunt down *R-11* with an appropriate resistor; if the attenuation is less than 10 db, shunt down *R-13* with an appropriate resistor.

*j.* Switch *S-2* to **AMPLIFIER** position and connect 75 ohm detector to **AMPLIFIER OUTPUT** jack. Connect X-axis amplifier of scope to detector output and flatten response using *L-13*.

*k.* Remove 1000$\mu\mu$f condenser and put *S-3* in **ON** position.

6. Hum balancing - To set a-c hum pot *(R-112)*, switch to .001V range and turn pot to get lowest meter reading with probe shorted.

## SECTION VI
## POWER SUPPLY INSTRUCTIONS

### A. DESCRIPTION.

The **MICROLTER** has its own power supply constructed on a separate chassis from the r-f circuitry. It supplies an electronically regulated d-c voltage which is adjustable between 225 and 275 volts and a saturable reactor regulator for the filaments.

This regulated power supply furnishes all filament and d-c power required by the circuits of the **MICROLTER**.

### B. TROUBLE LOCATION.

*POWER SUPPLY CIRCUIT TROUBLE SHOOTING CHART*

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Pilot light does not light. | Power switch in the off position. | Turn power switch to the **ON** position. |
| | No a-c line voltage. | Trace line failure |
| | Dial lamp open. | Replace lamp. |
| | Power cable defective. | Repair or replace cable. |
| | Power transformer defective. | Replace *T-201*. |
| | Fuse defective. | Replace *F-201*. |
| | Power switch defective. | Replace *S-4*. |
| Line fuse flows instantly when power is turned on. | Defective rectifier tube or filter capacitor. | Check filter capacitors *C-201* & *C-202* for low resistance or a short. If found to be good, replace rectifier tube *V-501*. *Note: If a filter capacitor is shorted, the rectifier tube should be checked as this may have been damaged.* |

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Some of the filaments fail to light. | Defective tube. | Replace burned out tube. |
| | Open lead from filament section of power transformer. | Repair break. |
| No B+ 250V. | Defective rectifier tube. | Replace rectifier tube. |
| | Power transformer or filter choke defective. | Replace *T-501* or *L-501*. |
| No 250V regulation | Defective tubes. | Check *V-202 thru V-206* and *I-201 & I-202*, neon lamps. |

## SECTION VII
## PARTS LIST

### A. POWER SUPPLY.

**RESISTORS:** (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE FIXED, ½ WATT COMPOSITION, 10% TOLERANCE RESISTORS.)

| | | | |
|---|---|---|---|
| R-201 | 330K; 1W | R-211 | 270K |
| R-202 | 33; 1W | R-212 | 6.8K; 1W |
| R-203 | 100; 1W | R-213 | 100K; B+ ADJ. |
| R-204 | 33; 1W | R-214 | 180K |
| R-205 | 100; 1W | R-215 | 12K; 2W |
| R-206 | 33; 1W | R-216 | 150K; 1W |
| R-207 | 100; 1W | R-217 | 330K; 1W |
| R-208 | 100; 1W | R-218 | 15K; 1W |
| R-209 | 100; 1W | R-219 | 12K; 1W |
| R-210 | 100; 1W | R-220 | 22 |

**CAPACITORS:** (ALL CAPACITORS IN $\mu\mu F$ UNLESS OTHERWISE INDICATED.)

| | |
|---|---|
| C-201 | 6$\mu F$; 600V; OIL |
| C-202 | 16$\mu F$; 600V; OIL |
| C-203 | 0.01$\mu F$; 500V |
| C-204 | 0.1$\mu F$; 400V |
| C-205 | 1000 |
| C-206 | *a & b* 20$\mu F$; ELECTROLYTIC |
| C-207 | 10$\mu F$; 450V |

**TUBES:**

| | |
|---|---|
| V-201 | 5U4G |
| V-202 | 6AQ5 |
| V-203 | 6AQ5 |
| V-204 | 6AQ5 |
| V-205 | 12AU7 |
| V-206 | 6AQ5 |
| V-207 | OB2 |

**MISCELLANEOUS:**

| | |
|---|---|
| F-201 | 3 AMP; 250V FUSE |
| I-201 | NEON GLOW LAMP; GE NE-2 |
| I-202 | NEON GLOW LAMP; GE NE-2 |
| J-201 | 6-PRONG CABLE MOUNT; FEMALE |
| L-201 | 8.5 HENRY COIL |
| T-201 | HV TRANSFORMER (KA-2520) |
| T-202 | SOLA FILAMENT REGULATING TRANSFORMER |

**RESISTORS:** (UNLESS OTHERWISE SPECIFIED, ALL COMPONENTS ARE FIXED, ½ WATT COMPOSITION 10% TOLERANCE RESISTORS.)

| | | | | | |
|---|---|---|---|---|---|
| R-1 | 18; .1W | R-39 | 15 | R-77 | 22K; 1W |
| R-2 | 470K; .1W | R-40 | 1.5K | R-78 | 20K; GAIN ADJ. POT (INT) |
| R-3 | 1M; .1W | R-41 | 10 | R-79 | 150K |
| R-4 | 33K; .1W | R-42 | 2.7; 1W | R-80 | 4.7K |
| R-5 | 1M; .1W | R-43 | 470 | R-81 | 15 |
| R-6 | 22 | R-44 | 22 | R-82 | 1.5K |
| R-7 | 22 | R-45 | 4.7K; 2W | R-83 | 10 |
| R-8 | 750 | R-46 | 470K | R-84 | 2.7; 1W |
| R-9 | 22 | R-47 | 10 | R-85 | 470 |
| R-10 | 1K | R-48 | 200 | R-86 | 22 |
| R-11 | 390 | R-49 | 22K; 1W | R-87 | 4.7K; 2W |
| R-12 | FACTORY SELECTED | R-50 | 20K; GAIN ADJ. POT (INT) | R-88 | 470K |
| R-13 | 220 | R-51 | 150K | R-89 | 10 |
| R-14 | 2.7; 1W | R-52 | 4.7K | R-90 | 300 |
| R-15 | 470K | R-53 | 15 | R-91 | 22K; 1W |
| R-16 | 20K; GAIN ADJ. POT (INT) | R-54 | 1.5K | R-92 | 20K; GAIN ADJ. POT (IN. |
| R-17 | 4.7K | R-55 | 10 | R-93 | 470K |
| R-18 | 150K | R-56 | 2.7; 1W | R-94 | 4.7K |
| R-19 | 180 | R-57 | 470 | R-95 | 15 |
| R-20 | 15 | R-58 | 22 | R-96 | 6.8K |
| R-21 | 22 | R-59 | 4.7K; 2W | R-97 | 10 |
| R-22 | 4.7K; 2W | R-60 | 470K | R-98 | 2.7; 1W |
| R-23 | 10 | R-61 | 10 | R-99 | 470 |
| R-24 | 200 | R-62 | 200 | R-100 | 27 |
| R-25 | 22K; 1W | R-63 | 22K; 1W | R-101 | 27 |
| R-26 | 1K | R-64 | 20K; GAIN ADJ. POT (INT) | R-102 | 91K |
| R-27 | 10 | R-65 | 150K | R-103 | 39 |
| R-28 | 2.7; 1W | R-66 | 4.7K | R-104 | 1K; 2W |
| R-29 | 470 | R-67 | 15 | R-105 | 1.5K; 2W |
| R-30 | 22 | R-68 | 1.5K | R-106 | 82 |
| R-31 | 4.7K; 2W | R-69 | 10 | R-107 | 22 |
| R-32 | 470K | R-70 | 2.7; 1W | R-108 | 27K |
| R-33 | 10 | R-71 | 470 | R-109 | 2.7; 1W |
| R-34 | 200 | R-72 | 22 | R-110 | 5K; LINEARITY ADJ. POT |
| R-35 | 22K; 1W | R-73 | 4.7K; 2W | R-111 | 10M |
| R-36 | 20K; GAIN ADJ. POT (INT) | R-74 | 470K | R-112 | 200; HUM BALANCE POT |
| R-37 | 150K | R-75 | 10 | R-113 | 270K |
| R-38 | 4.7K | R-76 | 200 | | |

**CAPACITORS:** (ALL CAPACITORS IN μμF UNLESS OTHERWISE INDICATED.)

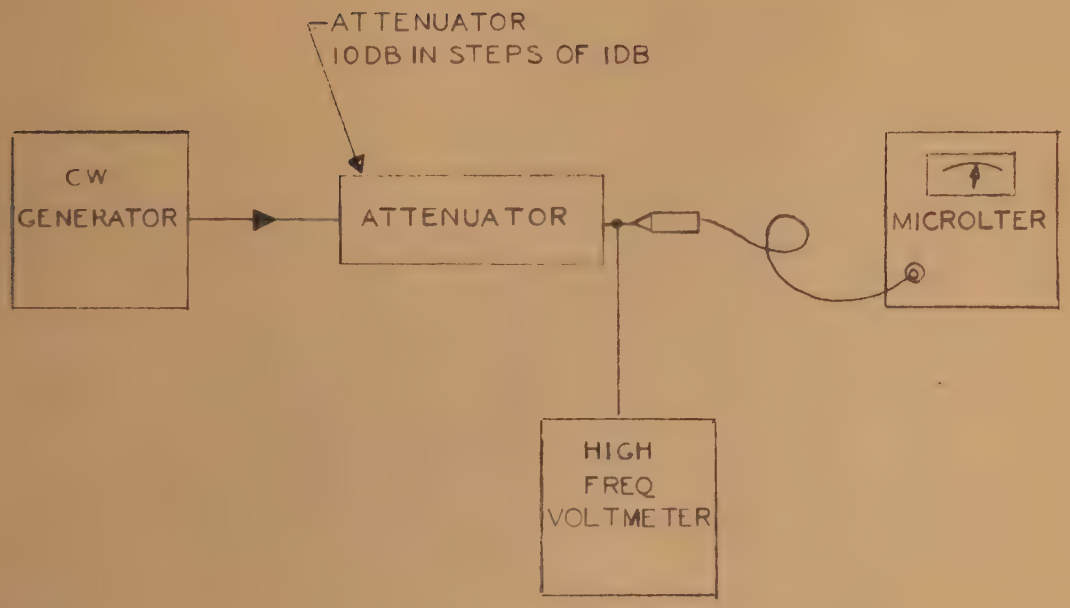
| | | | | | |
|---|---|---|---|---|---|
| C-1 | 4000 | C-22 | 0.02μF | C-41 | 0.02μF |
| C-2 | 10 | C-23 | 0.02μF | C-42 | 0.005μF |
| C-3 | 0.02μF | C-24 | 0.005μF | C-43A | 10μF; ELECTROLYTIC |
| C-4 | 0.002μF | C-25A | 10μF; ELECTROLYTIC | B | 5μF; ELECTROLYTIC |
| C-5 | 0.002μF | B | 5μF; ELECTROLYTIC | C | 150μF; ELECTROLYTIC |
| C-6 | 0.02μF | C | 150μF; ELECTROLYTIC | C-44 | 0.02μF |
| C-7 | 25μF; 25V | C-26 | 0.02μF | C-45 | 0.02μF |
| C-8 | 1-3 TRIMMER | C-27 | 0.02μF | C-46 | 0.02μF |
| C-9 | 0.02μF | C-28 | 0.02μF | C-47 | 0.02μF |
| C-10 | 20μF | C-29 | 0.02μF | C-48A | 10μF |
| C-11 | 0.02μF | C-30 | 0.005μF | B | 150μF |
| C-12 | 0.005μF | C-31A | 10μF; ELECTROLYTIC | C-49 | 10μF; 150V; ELECTROLYTIC |
| C-13 | 0.02μF | B | 5μF; ELECTROLYTIC | C-50 | 180 |
| C-14A | 10μF; ELECTROLYTIC | C | 150μF; ELECTROLYTIC | C-51 | 0.02μF |
| B | 5μF; ELECTROLYTIC | C-32 | 0.02μF | C-52 | 25μF; 25V; ELECTROLYTIC |
| C | 150μF; ELECTROLYTIC | C-33 | 0.02μF | C-53 | 0.02μF |
| C-15 | 0.02μF | C-34 | 0.02μF | C-54 | 0.02μF |
| C-16 | 0.02μF | C-35 | 0.02μF | C-55 | 1000 |
| C-17 | 0.02μF | C-36 | 0.005μF | C-56 | 1000 |
| C-18 | 0.005μF | C-37A | 10μF; ELECTROLYTIC | C-57 | 1000 |
| C-19A | 10μF; ELECTROLYTIC | B | 5μF; ELECTROLYTIC | C-58 | 1000 |
| B | 5μF; ELECTROLYTIC | C | 150μF; ELECTROLYTIC | C-59 | 1000 |
| C | 150μF; ELECTROLYTIC | C-38 | 0.02μF | C-60 | 1000 |
| C-20 | 0.02μF | C-39 | 0.02μF | C-61 | 1000 |
| C-21 | 0.02μF | C-40 | 0.02μF | C-62 | 25μF; 25V; ELECTROLYTIC |
| | | | | C-63 | 33 |

**MISCELLANEOUS:**

D-1 THRU D-2 G76; HIGH FREQUENCY GERMANIUM DIODES IN538
J-1 UG-185/U AMPLIFIER OUTPUT JACK
L-1 THRU L-13 SPECIAL SHAPING COILS
L-14 THRU L-27 FILAMENT CHOKE
M-1 METER
I-1 INDICATOR LIGHT; 6.3V; BAYONET TYPE #44
P-1 JONES 6-PRONG CHASSIS MOUNT; MALE
S-1 2 SEGMENT, 2 WAFERS PER SEGMENT, GEARED TO A COMMON SHAFT RANGE SWITCH
S-2 METER - AMPLIFIER WAFER SWITCH
S-3 DPDT SWITCH
S-4 DPDT ON-OFF SWITCH

**TUBES**

V-1 5718
V-2 E180F
V-3 E180F
V-4 E180F
V-5 E180F
V-6 E180F
V-7 E180F
V-8 6BK7A




NOTE

A MATCHED SYSTEM SHOULD BE USED *eg.* A 75Ω SIGNAL GENERATOR AND A 75Ω ATTENUATOR TERMINATED IN 75Ω

FIG. 1

BLOCK DIAGRAM METER CALIBRATON MICROLTER

| MAT. | FINISH: | SCALE: |
|---|---|---|

DIMENSIONS TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL DIMENSIONS ± .002 FRACTIONAL DIMENSIONS ± .005

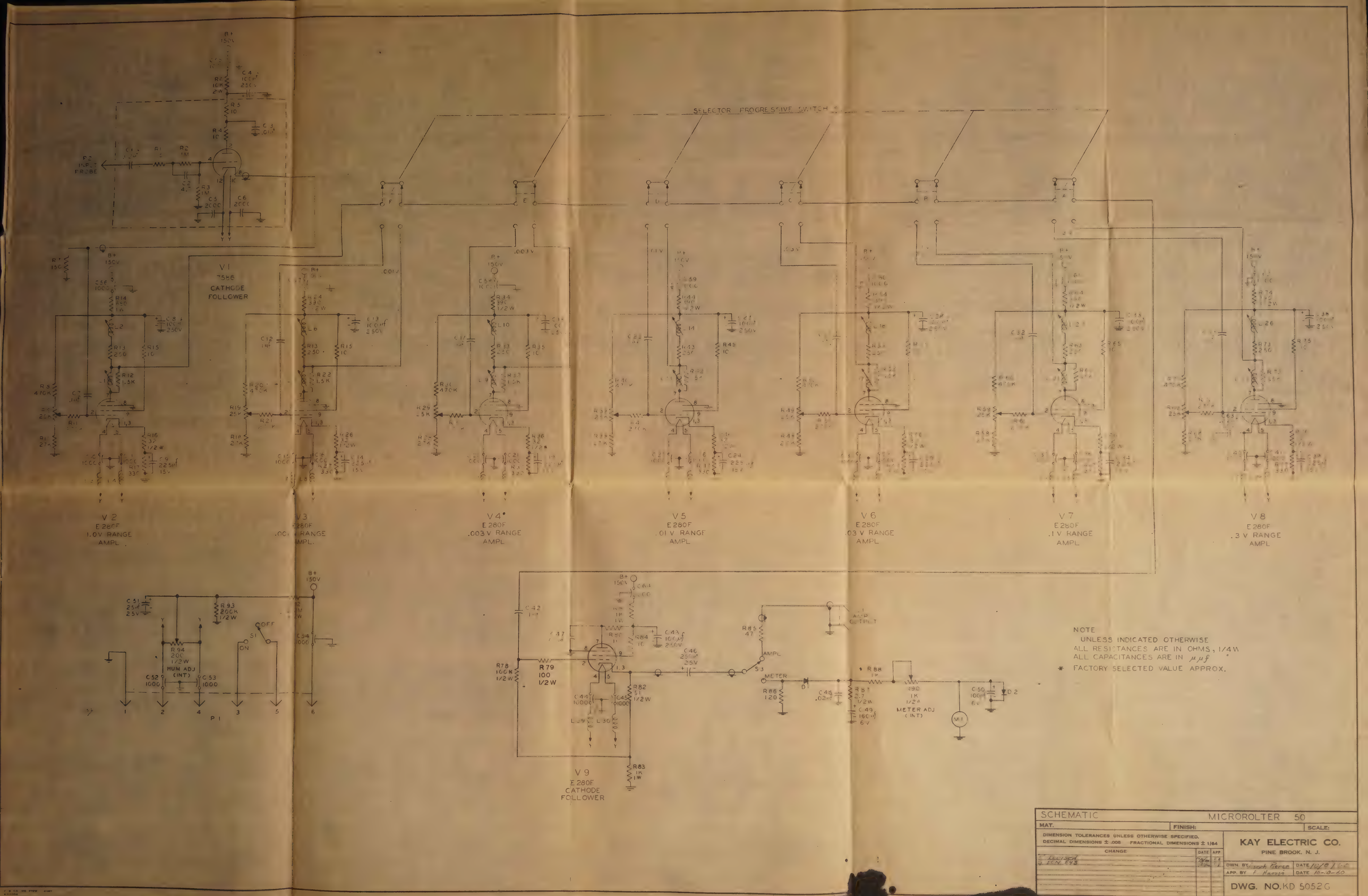
| CHANGE | DATE | APP. |
|---|---|---|
| | | |

**KAY ELECTRIC CO.**
PINE BROOK, N. J.

| | |
|---|---|
| DWN. BY AWP | DATE 12-5-57 |
| APP. BY [illegible] | DATE 12/5/57 |

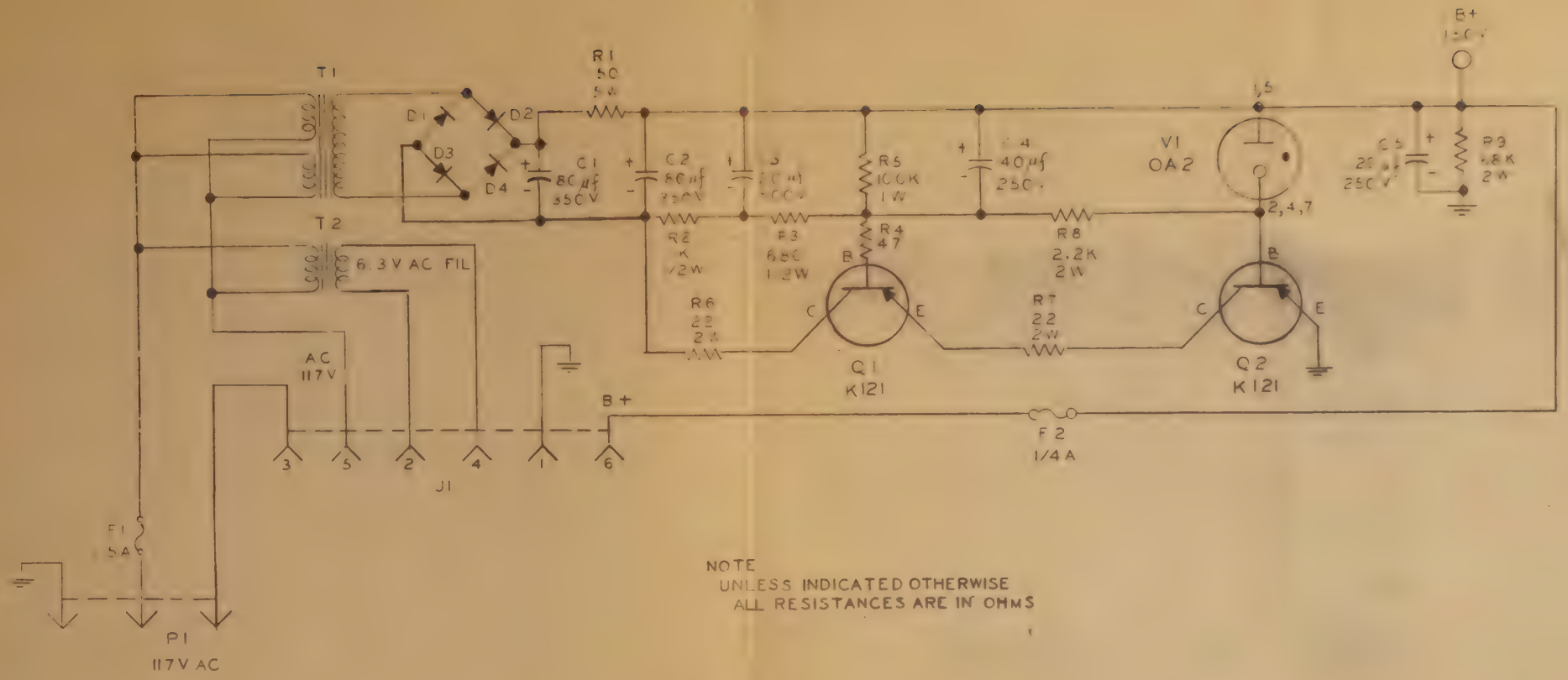
**DWG. NO.** KA 5543A

R. S. KNAPP CO., INC. KP-1001 11814




NOTE
UNLESS INDICATED OTHERWISE
ALL RESISTANCES ARE IN OHMS, 1/4W
ALL CAPACITANCES ARE IN $\mu\mu f$
* FACTORY SELECTED VALUE APPROX.

| | | | |
|---|---|---|---|
| SCHEMATIC | MICROROLTER 50 | | |
| MAT. | FINISH: | | SCALE: |
| DIMENSION TOLERANCES UNLESS OTHERWISE SPECIFIED. DECIMAL DIMENSIONS ± .006 FRACTIONAL DIMENSIONS ± 1/64 | | KAY ELECTRIC CO. PINE BROOK, N. J. | |
| CHANGE | DATE / APP | DWN. BY Jack Pierce | DATE 10/2/60 |
| | | APP. BY F. Hansen | DATE 10-3-60 |
| | | DWG. NO. KD 5052G | |




NOTE
UNLESS INDICATED OTHERWISE
ALL RESISTANCES ARE IN OHMS

SCHEMATIC POWER SUPPLY MODEL 2150

| MAT. | FINISH: | SCALE: |
|---|---|---|

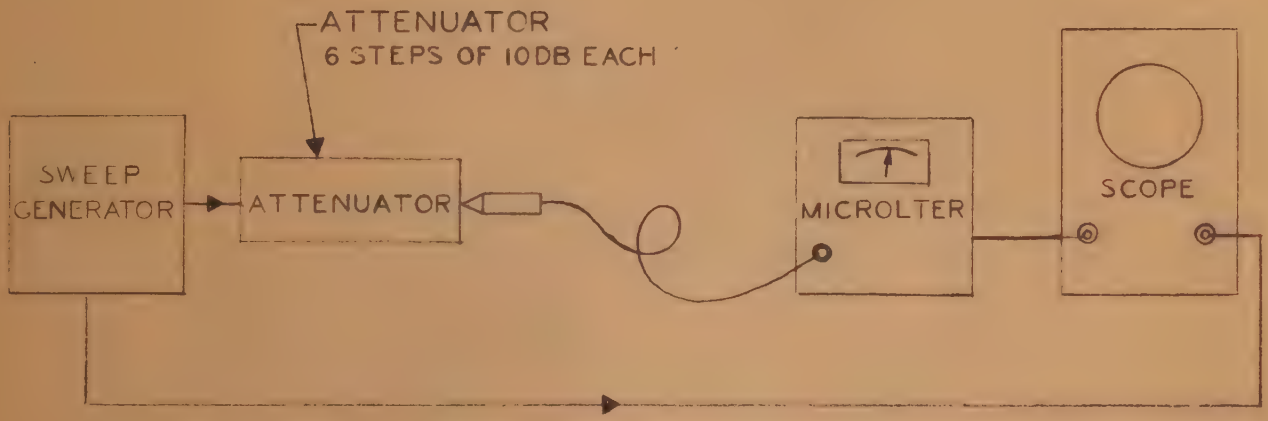
DIMENSIONS TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL DIMENSIONS ± .002 FRACTIONAL DIMENSIONS ± .005

KAY ELECTRIC CO.
PINE BROOK, N. J.

| CHANGE | DATE | APP. |
|---|---|---|
| "B" Removed at Solenoid F2 CHANGED TO R5 R8 | 9/60 | F H |

DWN. BY A.W.P DATE 9/29/60
APP. BY F. Hansen DATE 9/29/1960

DWG. NO. KB 6842 F




NOTE 1

A MATCHED SYSTEM SHOULD BE USED *eg.* A 75Ω SIGNAL GENERATOR AND A 75Ω ATTENUATOR TERMINATED IN 75Ω

NOTE 2

SCOPE VERTICAL AMPLIFIER SHOULD BE CONNECTED AT JUNCTION OF S3 AND R109

FIG. 2

BLOCK DIAGRAM AMPLIFIER ALIGNMENT MICROLTER

| MAT. | FINISH: | SCALE: |
|---|---|---|

DIMENSIONS TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL DIMENSIONS ± .002 FRACTIONAL DIMENSIONS ± .005

| CHANGE | DATE | APP. |
|---|---|---|
| | | |

**KAY ELECTRIC CO.**
PINE BROOK, N. J.

| | |
|---|---|
| DWN. BY AWP | DATE 12-5-57 |
| APP. BY [illegible] | DATE 12/5/57 |

**DWG. NO.** KA 5544 A

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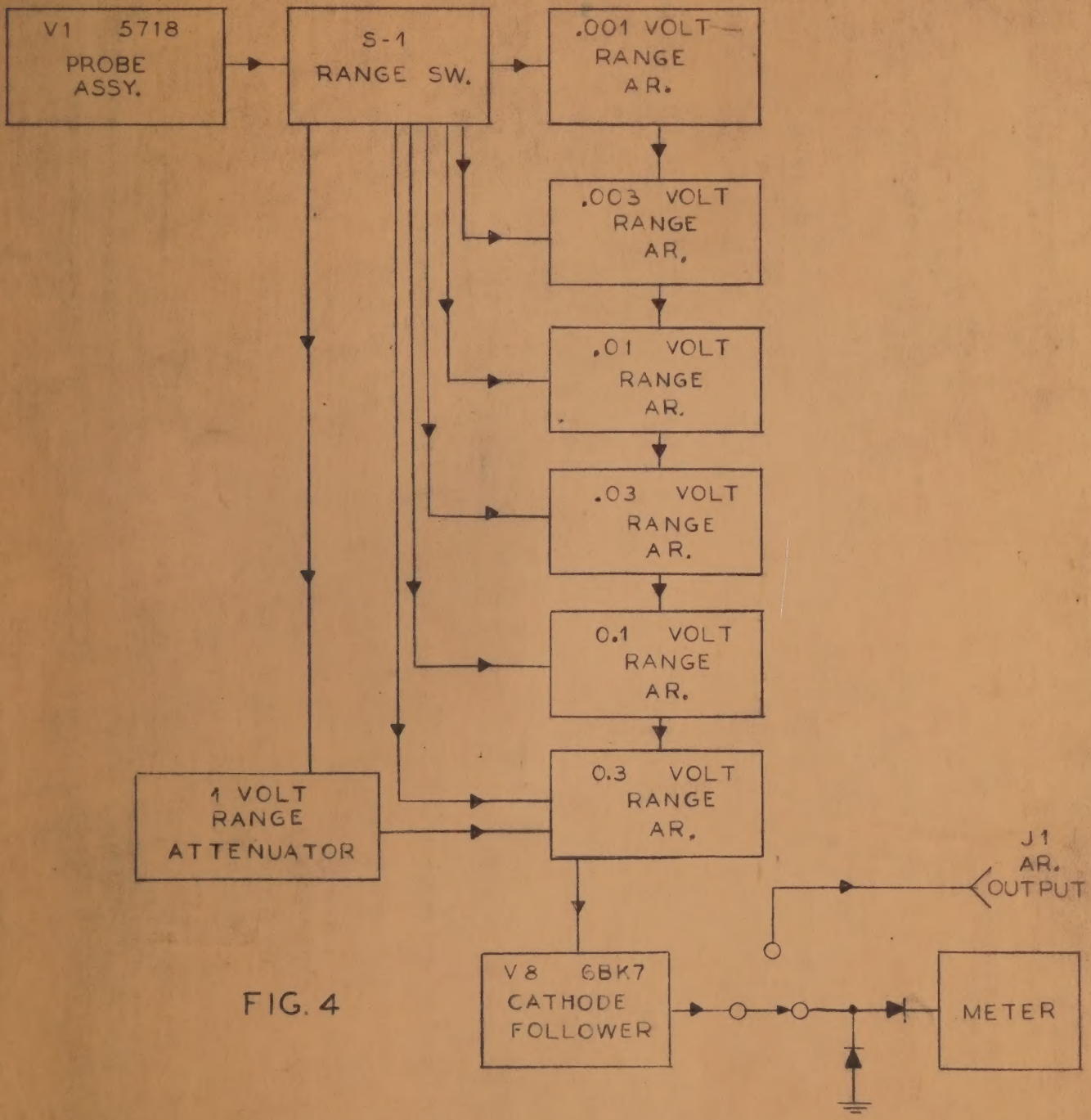


FIG. 4

BLOCK DIAGRAM for MICROLTER 50MC

| MAT. | FINISH: | SCALE: |
|---|---|---|

DIMENSIONS TOLERANCES UNLESS OTHERWISE SPECIFIED:
DECIMAL DIMENSIONS ± .002 FRACTIONAL DIMENSIONS ± .005

| CHANGE | DATE | APP. |
|---|---|---|
| | | |

KAY ELECTRIC CO.
PINE BROOK, N. J.

| | |
|---|---|
| DWN. BY Joseph Pierce | DATE 9/17/57 |
| APP. BY T Doherty | DATE 9/17/57 |

DWG. NO. KA5458

R. S. KNAPP CO., INC. KP-1001 11854

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